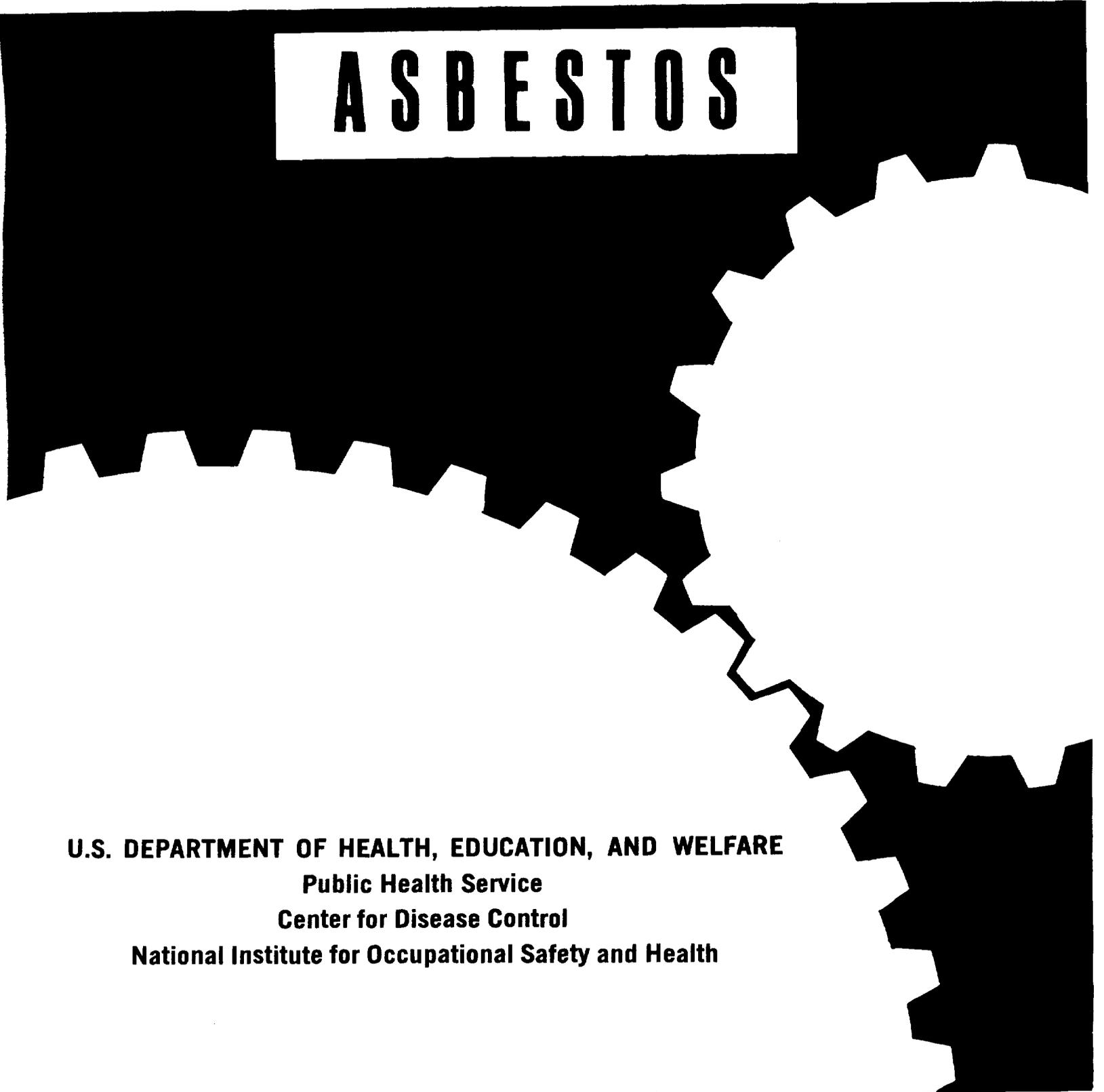


criteria for a recommended standard

OCCUPATIONAL EXPOSURE TO

ASBESTOS



**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health**

criteria for a recommended standard

**OCCUPATIONAL EXPOSURE
TO
ASBESTOS**



**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health**

1972

HSM 72-10267
Second Printing

PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health of workers exposed to an ever increasing number of potential hazards at their workplace. To provide relevant data from which valid criteria and effective standards can be deduced, the National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices.

It is intended to present successive reports as research and epidemiologic studies are completed and sampling and analytic methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of the worker.

I am pleased to acknowledge the contributions to this first report on asbestos by members of my staff, and the valuable constructive comments by the Review Consultants on Asbestos. A list of these contributors and reviewers appears on pages iii and iv. The contributions of others are also acknowledged:

Dohrman H. Byers*
Bureau of Occupational
Safety and Health
Cincinnati, Ohio

Andrew D. Hosey*
Bureau of Occupational
Safety and Health
Cincinnati, Ohio

Bobby J. Gunter, Ph.D.:
Bureau of Occupational
Safety and Health **
Cincinnati, Ohio

Glen W. Sutton*
Bureau of Occupational
Safety and Health
Cincinnati, Ohio

Richard E. Kinser
Bureau of Occupational
Safety and Health **
Cincinnati, Ohio

John L. Holtz
Bureau of Occupational
Safety and Health **
Cincinnati, Ohio

Roger A. Nelson*
Bureau of Occupational
Safety and Health
Cincinnati, Ohio

Edward J. Baier
Occupational Health
Program
Pennsylvania Department of Health

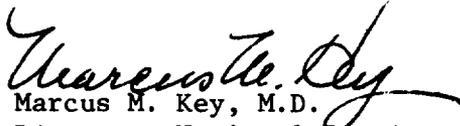
Paul Gross, M.D.
Graduate School of Public Health
University of Pittsburgh

John C. Lumsden
North Carolina State
Board of Health

Morris Kleinfeld, M.D.
New York State Department
of Health

Irving J. Selikoff, M.D.
Mount Sinai School of Medicine
City University of New York

Douglas H. K. Lee, M.D.
National Institute of
Environmental Health Sciences


Marcus M. Key, M.D.
Director, National Institute
for Occupational Safety and Health

*former staff

**now National Institute for Occupational Safety and Health

REVIEW COMMITTEE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

Howard E. Ayer
Assistant Director, Division of
Field Studies and Clinical Investigations

John V. Crable
Acting Chief, Laboratory of Physical
and Chemical Analysis

Bobby F. Craft, Ph.D.
Acting Director, Division of Technical
Services

Lewis J. Cralley, Ph.D.
Office of the Associate Director,
Cincinnati Operations

Lorice Ede, J.D.
Office of Research & Standards
Development

Edward J. Fairchild, Ph.D.
Acting Associate Director, NIOSH
Cincinnati Operations

William M. Johnson, M.D.
Associate Director, Division of
Field Studies and Clinical Investigations

Jeremiah R. Lynch
Acting Deputy Director,
Division of Laboratories
and Criteria Development

Raymond T. Moore, M.D.
Associate Director, NIOSH
Washington Operations

Charles H. Powell, Sc.D.
Assistant Director, NIOSH
for Research and Standards
Development

Warren L. Smith, M.D.
Division of Field Studies
and Clinical Investigations

Herbert E. Stokinger, Ph.D.
Division of Laboratories and
Criteria Development

Joseph K. Wagoner, S.D. Hyg.
Director, Division of Field
Studies and Clinical Inves-
tigations

NIOSH REVIEW CONSULTANTS ON ASBESTOS

W. Clark Cooper, M.D.
Professor in Residence
Occupational Health
Division of Environmental Health Sciences
University of California
School of Public Health
Berkeley, California

Duncan A. Holaday
Research Professor
Mount Sinai School of Medicine
City University of New York
New York, New York

George W. Wright, M.D.
Head, Department of Medical Research
St. Lukes Hospital
Cleveland, Ohio

**CRITERIA DOCUMENT: RECOMMENDATIONS FOR AN
OCCUPATIONAL EXPOSURE STANDARD FOR ASBESTOS**

Table of Contents

PREFACE

REVIEW COMMITTEES

I RECOMMENDATIONS FOR AN ASBESTOS STANDARD

- Section 1 - Environmental**
- Section 2 - Medical**
- Section 3 - Labeling**
- Section 4 - Personal Protective Equipment
and Clothing**
- Section 5 - Appraisal of Employees of Hazards from Asbestos**
- Section 6 - Work Practices**
- Section 7 - Monitoring & Recordkeeping Requirements**

II INTRODUCTION

III BIOLOGIC EFFECTS OF EXPOSURE

- Extent of Exposure**
- Early Historical Reports**
- Epidemiological Studies**
- Animal Toxicity**
- Correlation of Exposure and Effect**

IV ENVIRONMENTAL DATA

V DEVELOPMENT OF STANDARD

- Basis for Previous Standards**
- U. S. Emergency Standard**
- Basis for Recommended Standard**
- Summary**

VI COMPATIBILITY WITH EMISSION STANDARDS

VII REFERENCES

VIII APPENDIX I - Air Sampling Method

IX APPENDIX II - Numerical Hazard Rating System

X APPENDIX III - Material Safety Data Sheet

I. RECOMMENDATIONS FOR AN ASBESTOS STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that worker exposure to asbestos dust in the workplace be controlled by requiring compliance with the following sections. Control of worker exposure to the limits stated will prevent asbestosis and more adequately guard against asbestos-induced neoplasms. The standard is amenable to techniques that are valid, reproducible, and available to industry and governmental agencies. It will be subject to review and will be revised as necessary.

Section 1 - Environmental (work place air)

(a) Concentration

Occupational exposure to airborne asbestos dust shall be controlled so that no worker shall be exposed to more than 2.0 asbestos fibers per cubic centimeter (cc) of air based on a count of fibers greater than 5 micrometers ($>5 \mu\text{m}$) in length ((determined by the membrane filter method at 400-450X magnification (4 millimeter objective) phase contrast illumination, as described in Appendix I)), determined as a time-weighted average (TWA) exposure for an 8-hour work day, and no peak concentration of asbestos to which workers are exposed shall exceed 10.0 fibers/cc $>5 \mu\text{m}$ as determined by a minimum sampling time of fifteen minutes.

(b) Sampling

Procedures for sampling, calibration of equipment, and analysis of asbestos samples shall be as provided in Appendix I.

(c) It is recommended that this Section I become effective two years after promulgation as a standard, and that until the date of

publication, the present emergency standard for exposure to asbestos dust (29 CFR 1910.93a) shall be in effect. This period is believed necessary to permit installation of necessary engineering controls.

Section 2 - Medical

Medical surveillance is required, except where a variance from the medical requirements of this proposed standard have been granted, for all workers who are exposed to asbestos as part of their work environment. For purposes of this requirement the term "exposed to asbestos" will be interpreted as referring to time-weighted average exposures above 1 fiber/cc or peak exposures above 5 fibers/cc. The major objective of such surveillance will be to ensure proper medical management of individuals who show evidence of reaction to past dust exposures, either due to excessive exposures or unusual susceptibility. Medical management may range from recommendations as to job placement, improved work practices, cessation of smoking, to specific therapy for asbestos-related disease or its complications. Medical surveillance cannot be a guide to adequacy of current controls when environmental data and medical examinations only cover recent work experience because of the prolonged latent period required for the development of asbestosis and neoplasms.

Required components of a medical surveillance program include periodic measurements of pulmonary function (forced vital capacity (FVC)), and forced expiratory volume for one second (FEV_1), and periodic chest roentgenograms (postero-anterior 14 x 17 inches). Additional medical requirement components include a history to describe smoking habits and details on past exposures to asbestos and other dusts and to determine presence or absence of pulmonary, cardiovascular, and gastrointestinal symptoms, and a physical examination, with special attention to pulmonary rales, clubbing of fingers, and other signs related to cardiopulmonary systems.

Chest roentgenograms and pulmonary function tests will be performed at the employer's expense, at least every 2 years on all employees exposed to asbestos. These tests will be made annually to individuals, (1) who have a history of 10 or more years of employment involving exposure to asbestos or, (2) who show roentgenographic findings (such as small opacities, pleural plaques, pleural thickening, pleural calcification) which suggest or indicate pneumoconiosis or other reactions to asbestos, or (3) who have changes in pulmonary function which indicate restrictive or obstructive lung disease.

Preplacement medical examinations and medical examinations on the termination of employment of asbestos exposed workers are also required.

Section 3 - Labeling

(a) A warning label for asbestos as shown in Figure 1 shall be used.

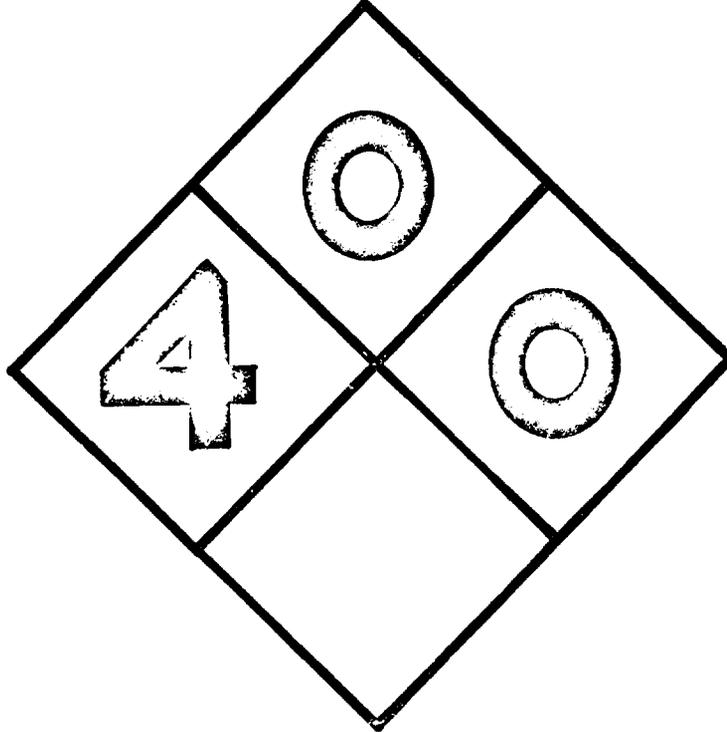
(b) Numerical designations indicate the following:

(i) 4= Health Hazard (color code, blue). Inhalation may cause asbestosis, pleural or peritoneal mesothelioma, or lung cancer.

(ii) 0= Fire Hazard (color code, red). Asbestos is non-flammable and has negligible vapor pressure, volatility, flash point, and explosive limits.

(c) The details of the numerical hazard rating system are found in Appendix II.

ASBESTOS



HARMFUL: May Cause Delayed Lung Injury
(Asbestosis, Lung Cancer).

DO NOT BREATHE DUST

Use only with adequate ventilation and
approved respiratory protective devices.

Section 4 - Personal Protective Equipment and Clothing

This section shall apply whenever a variance from the standard set in Section I is granted under provisions of the Occupational Safety and Health Act.* Use of respirators can be decided on the basis of time-weighted average or peak concentration. When the limits of exposure to asbestos dust prescribed in paragraph (a) of Section 1 cannot be met by limiting the concentration of asbestos dust in the work environment, an employer must utilize as provided in subsections (a) and (b) of this Section a program of respiratory protection and furnishing of protective clothing to effect the required protection of every worker exposed.

(a) Respiratory Protection

(i) For the purpose of determining the class of respirator to be used, the employer shall measure the atmospheric concentration of airborne asbestos in the workplace when the initial application for variance is made and thereafter whenever process, worksite, climate or control changes occur which are likely to affect the asbestos concentration. The employer shall test for respirator fit and/or make asbestos measurements within the respiratory inlet covering to insure that no worker is being exposed to asbestos in excess of the standard either because of improper respirator selection or fit.

(ii) As noted above, the use of respirators and protective clothing can be decided on the basis of either time-weighted average or peak concentrations. For determining usage or compliance, the peak concentration of 10 fibers/cc is preferable.

*Variance procedures will not be required for emergency and occasional short-term exposures in excess of the environmental standard. However, the use of respirator equipment as indicated in this Section (4) will be required under conditions in excess of the standard.

(iii) For an atmosphere containing not more than 10 fibers/cc greater than 5 μm in length over an 8-hour average or more than 50 fibers/cc over any 15 minute period, a reusable or single use filter-type air-purifying respirator, operating with a negative pressure during the inhalation phase of breathing, approved under the provisions of 30 CFR 14 (Bureau of Mines Schedule 21B) or valveless respirators providing equivalent protection shall be used.

(iv) For an atmosphere containing not more than 100 fibers/cc greater than 5 μm in length over an 8-hour average or more than 500 fibers/cc over any 15 minute period, a powered air-purifying positive-pressure respirator approved under the provisions of 30 CFR 14 (Bureau of Mines Schedule 21B) shall be used.

(v) For an atmosphere containing more than 100 fibers/cc greater than 5 μm in length over an 8-hour average or over 500 fibers/cc for any period in excess of 15 minutes, a type C positive-pressure supplied air respirator approved under the provisions of 30 CFR 12 (Bureau of Mines Schedule 19B) shall be used.

(vi) The employer shall establish a respirator program in accordance with the requirements of the American National Standard for Respiratory Protection Z88.2--1969.

(b) Protective Clothing

(i) The employer shall provide each employee subject to exposure in a variance area with coveralls or similar full body protective clothing and hat, which shall be worn during the working hours in areas where there is exposure to asbestos dust.

(ii) The employer shall provide for maintenance and laundering of the soiled protective clothing, which shall be stored, transported and disposed of in sealed non-reusable containers marked "Asbestos-Contaminated Clothing" in easy-to-read letters.

(iii) Protective clothing shall be vacuumed before removal. Clothes shall not be cleaned by blowing dust from the clothing or shaking.

(iv) If laundering is to be done by a private contractor, the employer shall inform the contractor of the potentially harmful effects of exposure to asbestos dust and of safe practices required in the laundering of the asbestos-soiled work clothes.

(v) Resin-impregnated paper or similar protective clothing can be substituted for fabric type of clothing.

(vi) It is recommended that in highly contaminated operations (such as insulation and textiles) provisions be made for separate change rooms.

Section 5 - Appraisal of Employees of Hazards from Asbestos

Each employee exposed to asbestos shall be apprised of all hazards, relevant symptoms, and proper conditions and precautions concerning use or exposure. Each exposed worker shall be informed of the information which is applicable to a specific product or material containing 5% or more asbestos (see Appendix III for details of information required). The information shall be kept on file and readily accessible to the worker at all places of employment where asbestos materials are manufactured or used in unit processes and operations. It is recommended, but not required, that this information be provided for asbestos processes and operations where the asbestos content is less than 5%.

Information as specified in Appendix III shall be recorded on U. S. Department of Labor Form OSHA-20, "Material Safety Data Sheet", (see page X-3 and X-4), or a similar form approved by the Occupational Safety and Health Administration, U. S. Department of Labor.

Section 6 - Work Practices

(a) Asbestos cement, mortar, coatings, grout, and plaster shall be mixed in closed bags or other containers.

(b) Asbestos waste and scrap shall be collected and disposed of in sealed bags or other containers.

(c) All cleanup of asbestos dust shall be performed by vacuum cleaners or wet cleaning methods. No dry sweeping shall be performed.

Section 7 - Monitoring and Recordkeeping Requirements

Employers will be required* to maintain records of environmental exposure to asbestos based upon the following environmental sampling and recordkeeping schedule. Personal exposure samples will be collected at least annually by specific maximum-risk work operations from a number of employees. The first sampling period will be completed within 180 days of the date of this standard. These selected samples will be collected and evaluated as both time-weighted and peak concentration values. The personal sampling regime shall be on a quarterly basis for maximum-risk work areas under the following conditions:

- (a) The environmental levels are in excess of the standard.
- (b) There are other conditions existing that necessitate the requesting of a variance from the Department of Labor.

Records of the type of respiratory protection in use during the quarterly sampling schedule must also be maintained. Quarterly sampling, monitoring and recordkeeping will be required only until environmental levels comply with the standard.

*Except where a variance for monitoring and recordkeeping has been granted.

II. INTRODUCTION

This report presents the criteria and the standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to asbestos dust. The necessary relevant data are made available for use by the Secretary, Department of Health, Education, and Welfare in accordance with the provision of the Occupational Safety and Health Act of 1970 requiring the development of criteria by "The Secretary, Department of Health, Education, and Welfare...on the basis of such research, demonstrations, and experiments and any other information available to him...to effectuate the purposes of this Act."..., "...: by providing medical criteria which will assure insofar as practicable that no employee will suffer diminished health, functional capacity, or life expectancy as a result of his work experience"...

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultations with others, formalized a system for the development of criteria upon which standards can be established to protect the health of workers from exposure to hazardous chemical and physical agents. It should be pointed out that any recommended criteria for a standard should enable management and labor to develop better engineering controls and more healthful work practices and should not be used as a final goal.

These criteria for a standard for asbestos dust are the first of the criteria developed by NIOSH. The criteria and standard speak only to the processing, manufacture, and use of asbestos products as applicable under the Occupational Safety and Health Act of 1970.

The occupational safety and health aspects of the mining and milling of asbestos ores are covered by provisions of the Federal Metal and Nonmetallic Mine Safety Act (30 US.C. 725 et seq.) under which provisions the Bureau of Mines has promulgated applicable regulations. Relevant data, however, bearing on the safety and health hazards from exposure to asbestos dust in the mining and milling of ores were considered in this document.

These criteria were developed to assure that the standard based thereon would, (1) protect against asbestosis and asbestos-induced neoplasms, (2) be amenable to techniques that are valid, reproducible, and available to industry and official agencies, and (3) be attainable with existing technology.

The recommended standard is designed primarily to prevent asbestosis. For other diseases associated with asbestos, there is insufficient information to establish a standard to prevent such diseases including asbestos-induced neoplasms by any all-inclusive limit other than one of zero. Nevertheless, a safety factor has been included in arriving at the concentration level that will reduce the total body burden and should more adequately guard against neoplasms.

Asbestos has been mined, milled, processed, and used for many years, and as a result, a number of workers have experienced significant accumulative exposure to asbestos dust over a working lifetime. It has been recognized that biological monitoring (by periodic chest roentgenograms) and removal from further exposure after initiation of fibrosis, calcification or neoplasia will not absolutely prevent

further progression of asbestosis or the clinical development of neoplasms. Therefore, it is absolutely essential that a low level of concentration be set to preclude the initiation of diseases resulting from exposure to asbestos. And of necessity, any prolonged delay in the establishment of the standard may require a more stringent standard in the future to assure the reduced total body burden of employees which is necessary to protect their safety and health.